USER'S MANUAL

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I. GETTING STARTED

1.1. Introduction

When it comes to medical imaging, the ability to see the whole image is important. With a standard workstation configuration using an uncalibrated display, the user runs the risk of missing fine details. Missing fine details can represent a health risk to the patient, which may lead to a misdiagnosis or an expensive lawsuit. The problem is not the image or the practitioner's eye; it is the ability of the display to represent all information accurately.

PerfectLum Suite is a software solution which enables the user to modify display output to meet DICOM part 14 GSDF and other key industry standards. After calibration your workstation will allow you to see the finest details of every image displayed. With PerfectLum Suite medical display calibration software installed on all of your computers, you are assured that no matter which image you are looking at, it will be the same on every display.

PerfectLum Suite is not only a DICOM calibration tool, but also a medical monitor QA application, that verifies the display's conformance to medical standards AAPM TG18, DIN 6868-57, DIN 6868-157, JESRA X-0093, IEC 62563-1, the New York state Primary Diagnostic Monitor (PDM) Quality Assurance Program and performs acceptance and conformance tests for these standards.

This document provides details on installation and use of the PerfectLum Suite application.

About PerfectLum Suite

PerfectLum Suite is a medical monitor quality assurance suite based on the medical standards NEMA DICOM part 14 GSDF, AAPM TG18, DIN 6868-57, DIN 6868-157, JESRA X-0093, IEC 62563-1 and NY PDM. The medical monitor QA tool performs calibration, acceptance test, conformance test and maintains consistency to all medical workstations. The use of this software enables healthcare professionals to maintain international standards of quality in terms of their displays performance.

PerfectLum Suite Features

- Calibration of all displays to DICOM part 14 GSDF, CIE L*, BT.709 and BT.1886 standard
- Update of video card LUT or display LUT for displays that comply with the DDC/CI standard
- Calibration of multi-head display systems
- White level and black level calibration
- Version 4 ICC profile generation
- Calibration to a certain color temperature and XY coordinates
- Verification of conformance to the major regulations: AAPM TG18, DIN 6868-57, DIN 6868-157, JESRA X-0093, IEC 62563-1 and the New York state Primary Diagnostic Monitor (PDM) Quality Assurance Program
- Automated QA - performing acceptance and conformance tests
- Scheduling conformance test automatically and reminders to perform tests
- Remote quality control
- Convenient and user-friendly calibration and QA reports
- Color measurement capability
- Diversified auto backup
- History log for comparing and checking results of calibrations
- Briggs, SMPTE, AAPM test patterns to visually check calibration results
- Wide OS compatibility, including Windows 8.1 and Mac OSX 10.9.4
- Many brands of photometer support
- License supports all users on the installed workstation

1.2. Minimum system requirements

1.2.1.PerfectLum client is supported on the following operating systems:

- Windows:
  - XP (32-bit and 64-bit)
  - Vista (32-bit and 64-bit)
  - Win 7 (32-bit and 64-bit)
  - Win 8 (32-bit and 64-bit)

Processor: Pentium or AMD K7
Minimum RAM: 512MB.
Minimum free space on hard disk: 150 MB.

- Mac OS X
  - 10.6 Snow Leopard (32-bit and 64-bit)
  - 10.7 Lion
  - 10.8 Mountain Lion
  - 10.9 Mavericks
  - 10.10 Yosemite
  - Intel hardware is required

Processor: Intel only. No PowerPC support.
Minimum RAM: 512MB.
Minimum free space on hard disk: 150 MB.

1.2.2. PerfectLum Remote server is supported on the following operating systems:

- Windows hosts:
  - Windows XP, all service packs (32-bit)
  - Windows Server 2003 (32-bit)
  - Windows Vista (32-bit and 64-bit).
  - Windows Server 2008 (32-bit and 64-bit)
  - Windows Server 2012
  - Windows 7 (32-bit and 64-bit)
  - Windows 8 (32-bit and 64-bit)
  - Windows 8.1 (32-bit and 64-bit)

- Mac OS X hosts:
  - 10.6 Snow Leopard (Intel 32-bit and Intel 64-bit)
  - 10.7 Lion
  - 10.8 Mountain Lion
  - 10.9 Mavericks
  - 10.10 Yosemite

- Linux hosts (32-bit and 64-bit). Among others, this includes:
  - Ubuntu 6.06 ("Dapper Drake"), 6.10 ("Edgy Eft"), 7.04 ("Feisty Fawn"), 7.10 ("Gutsy Gibbon"), 8.04 ("Hardy Heron"), 8.10 ("Intrepid Ibex"), 9.04 ("Jaunty Jackalope"), 9.10 ("Karmic Koala"), 10.04 ("Lucid Lynx"), 10.10 ("Maverick Meerkat), 11.04 ("Natty Narwhal"), 11.10 ("Oneiric Ocelot"), 12.04 ("Precise Pangolin"), 12.10 ("Quantal Quetzal"), 13.04 ("Raring Ringtail"), 13.10 ("Saucy Salamander"), 14.04 ("Trusty Tahr")
  - Debian GNU/Linux 3.1 ("sarge"), 4.0 ("etch"), 5.0 ("lenny"), 6.0 ("squeeze"), 7.0 (“Wheezy”)
  - Oracle Enterprise Linux 4 and 5, Oracle Linux 6
  - Redhat Enterprise Linux 4, 5 and 6
  - Fedora Core 4 to 20
  - Gentoo Linux
  - SUSE Linux 9, 10 and 11, openSUSE 10.3, 11.0, 11.1, 11.2, 11.3, 11.4, 12.1, 12.2, 12.3, 13.1
  - Mandriva 2007.1, 2008.0, 2009.1, 2010.0 and 2010.1

1.2.3. Your web browser should be one of the following:

- Mozilla Firefox, version 3.5 or higher
- Safari, version 4 or higher
- Google Chrome, version 3 or higher
- Internet Explorer 8 or higher

1.3. Hardware requirements

1.3.1. Displays and Graphic boards:

- All LCD, CRT Displays and Projectors
- All currently commercially available graphic boards

1.3.2. Measurement devices:

Display Front Sensor	Colorimeter	Spectral photometer	Spot Luminance meter
LumiMED MM03A	X-Rite Eye-One display	X-Rite Eye-One Pro	IBA dosimetry / Wellhoefer LX Plus
LumiMED MM05A	X-Rite Eye-One display 2	X-Rite Eye-One Monitor	IBA dosimetry / Wellhoefer LX Can
Olorin VC19012	X-Rite Eye-One display Pro	PhotoResearch PR 670	Pehamed CD mon
Olorin MC20012	X-Rite Monaco OPTIX XR	IBA dosimetry / Wellhoefer LX Chroma	Pehamed CD LUX
Olorin VC21012	X-Rite DTP 94	JETI specbos 1001	Pehamed CD Lux plus
Sony LMD DM20	X-Rite Sequel Gamma 3	JETI specbos 2001	
Sony LMD DM30	X-Rite Sequel Chroma 4	JETI specbos 2101	
Sony LMD DM50	X-Rite Sequel Chroma 5	JETI specbos 4001	
Sony LMD DM20C	Datacolor Spyder3		
Sony LMD DM30C	Datacolor Spyder4		
Sony LMD DM50C	Konica Minolta CS200		
Totoku CCL254i2	Konica Minolta CA210		
Totoku CCL256i2			
Totoku CCL258i2			

1.3.3. Displays with internal LUT:

- NEC MultiSync LCD 1980
- NEC MultiSync LCD 2180
- IIYAMA PLH2130-2
- IIYAMA PLH2130-3
- LumiMED MM02
- LumiMED MM03
- LumiMED MM05
- LumiMED MM03A
- LumiMED MM05A
- Olorin VL211D
- Olorin VL200D
- Olorin VC210D
- Olorin VC19012
- Olorin MC20012
- Olorin VC21012
- Olorin MC210D
- Olorin VC190D
- Olorin MC190D
- Olorin MC200D
- Olorin VC210D
- Olorin MC191D
- Olorin MC221D
- Rein VIEWMEDIC EV-C119
- Rein VIEWMEDIC RV-C219
- Rein VIEWMEDIC RV-C221
- DELL U3011
- DELL U3014
- DELL U2413
- DELL UP2414Q
- DELL U2713H
- DELL U2414
- DELL UP3214Q
- Sony LMD DM20
- Sony LMD DM30
- Sony LMD DM50
- Sony LMD DM20C
- Sony LMD DM30C
- Sony LMD DM50C
- Totoku CCL254i2
- Totoku CCL256i2
- Totoku CCL258i2
- Totoku CCL352i2
- Totoku CCL354i2
- Totoku CCL356i2
- Totoku CCL358i2

1.4. Installation Procedure Overview

1.4.1. Pre-installation conditions:

In order to install PerfectLum Suite client you must have Administrator privileges or Administrator's password if required when installing to the user profile.

Before installing PerfectLum Suite software in your system:
Power on the workstation with all display(s) attached that you intend to use.
Check if the screen settings are correctly configured:

XP - Go to Settings -> Control panel, and double click on the display icon. Select the "Settings" tab to view screen resolution and color settings.

Vista - Go to Settings -> Control panel and click on "Adjust screen resolution" under the Appearance and Personalisation Icon.

Windows 7 and 8 – Go to Control panel -> Display -> Adjust resolution.

Mac OS X - System Preferences -> Displays and choose resolution radio box "Best for display".

Ensure that the screen resolution is set to the native resolution of the display with color quality of 32 bit "True color" or higher.
Ensure that the correct graphics card display driver is installed.
Repeat these checks for each display attached to your system.
Your system is now ready to start the installation process.

IMPORTANT: Before starting the installation process, please make sure that the USB measurement device is NOT connected. The measurement device will be added later, after PerfectLum Suite is successfully installed.

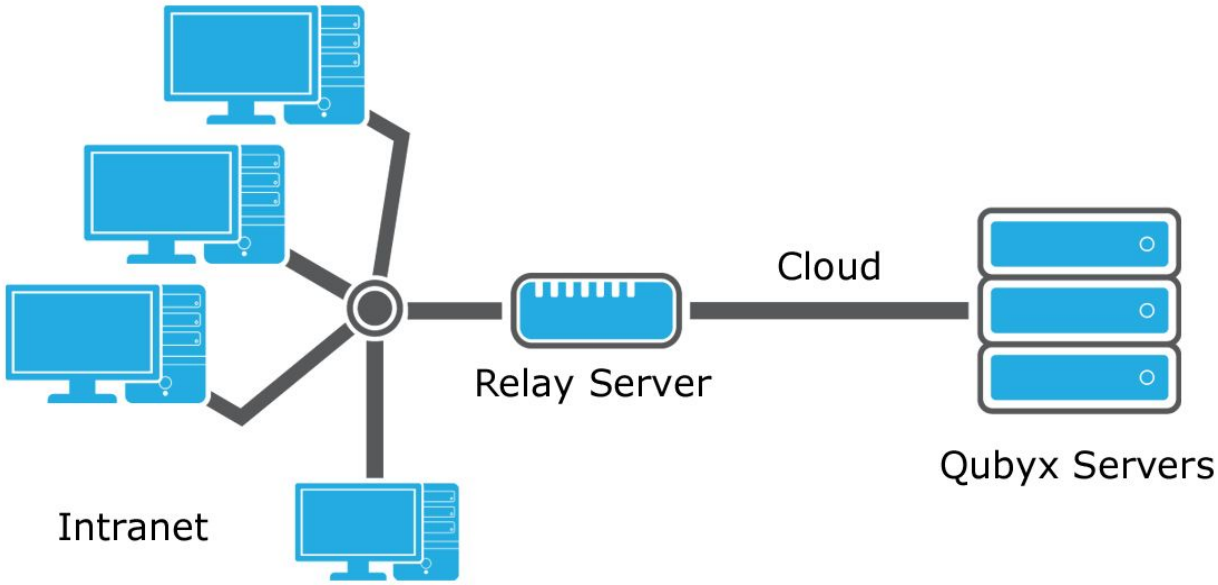
PerfectLum Suite can be operated as a client only or as a client-server combination.
Complete installation consists of several components.

PerfectLum Suite Client

PerfectLum Suite Client is the client application that runs on each of the workstations. It provides a number of actions that can be performed locally on the workstations, including calibrating the displays, viewing test patterns or performing full QA (Quality Assurance) and acceptance tests (QA tests available only in PerfectLum Suite). Even when PerfectLum Suite Client is not connected to PerfectLum Remote Server it can still run all QA tasks on the workstation.

PerfectLum Remote Server

All PerfectLum Suite clients can be connected to PerfectLum Remote Server. No special license is required. QA managers can connect to PerfectLum Remote Server via internet/intranet connection and take full control over the performance of connected workstations from any location at any given time.



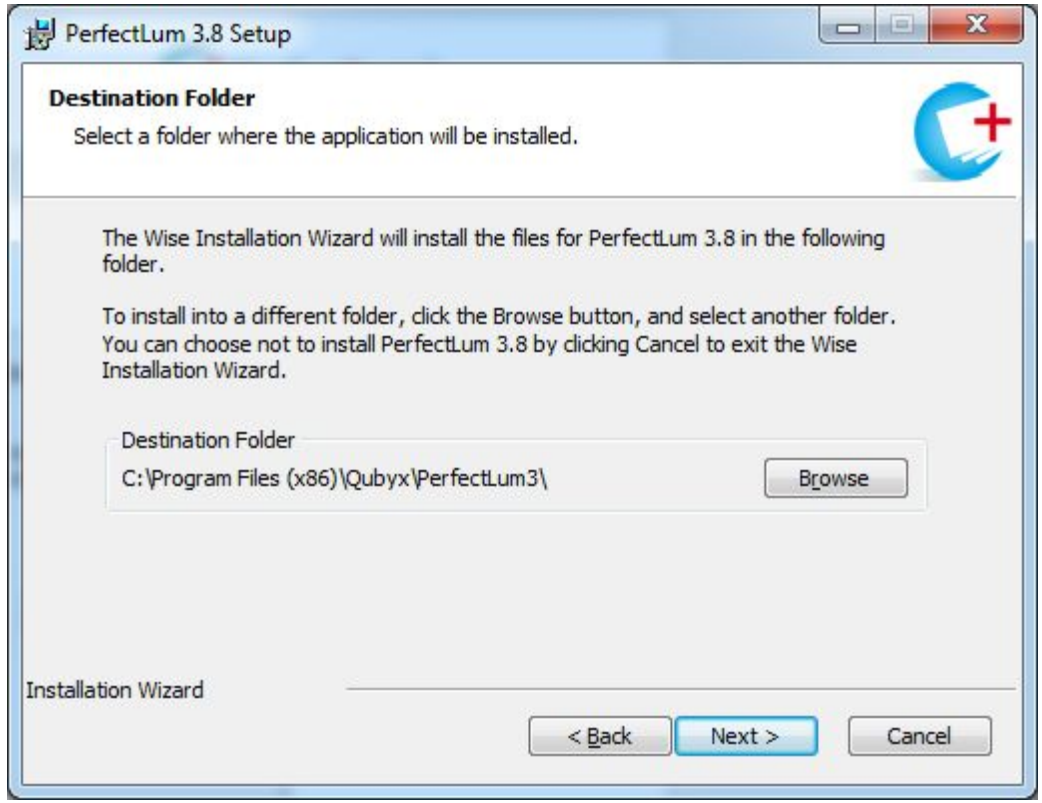
1.4.2. Installation

Windows Vista/7/8:

Double click on the installer:

PerfectLum 3.8 Setup
QUBYX
PerfectLum
Welcome to the PerfectLum 3.8 Installation Wizard
It is strongly recommended that you exit all Windows programs before running this setup program.
Click Cancel to quit the setup program, then close any programs you have running. Click Next to continue the installation.
WARNING: This program is protected by copyright law and international treaties.
Unauthorized reproduction or distribution of this program, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under law.
< Back
Next >
Cancel

Follow the instructions presented in the installer and click on the QUBYX software license agreement after reading it carefully.


PerfectLum 3.8 Setup
Destination Folder
Select a folder where the application will be installed.
The Wise Installation Wizard will install the files for PerfectLum 3.8 in the following folder.
To install into a different folder, click the Browse button, and select another folder.
You can choose not to install PerfectLum 3.8 by clicking Cancel to exit the Wise Installation Wizard.
Destination Folder
C:\Program Files (x86)\Qubyx\PerfectLum3\
Browse
Installation Wizard
< Back
Next >
Cancel

If you don’t want to install PerfectLum Suite into the default directory, browse your computer and choose another one.

Windows will present a driver message for a few times during PerfectLum Suite installation. This is normal behavior as drivers to support measurement devices are loaded. Please click the „Install this driver software anyway" button when prompted.

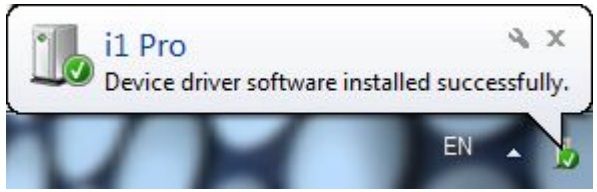
Windows Security
Windows can't verify the publisher of this driver software
Don't install this driver software
You should check your manufacturer's website for updated driver software for your device.
Install this driver software anyway
Only install driver software obtained from your manufacturer's website or disc. Unsigned software from other sources may harm your computer or steal information.
See details

1.4.3. Measurement Device Installation

Now that you have the software installed, it is time to install the measurement device. Plug the device into an unused USB port and refer to the following depending on which OS you have installed the software:

Vista and Windows 7

Vista and Windows 7 will automatically install your device driver. Wait until you receive the "Device driver software installed successfully" message, and jump ahead to the end of this section.



Windows XP:

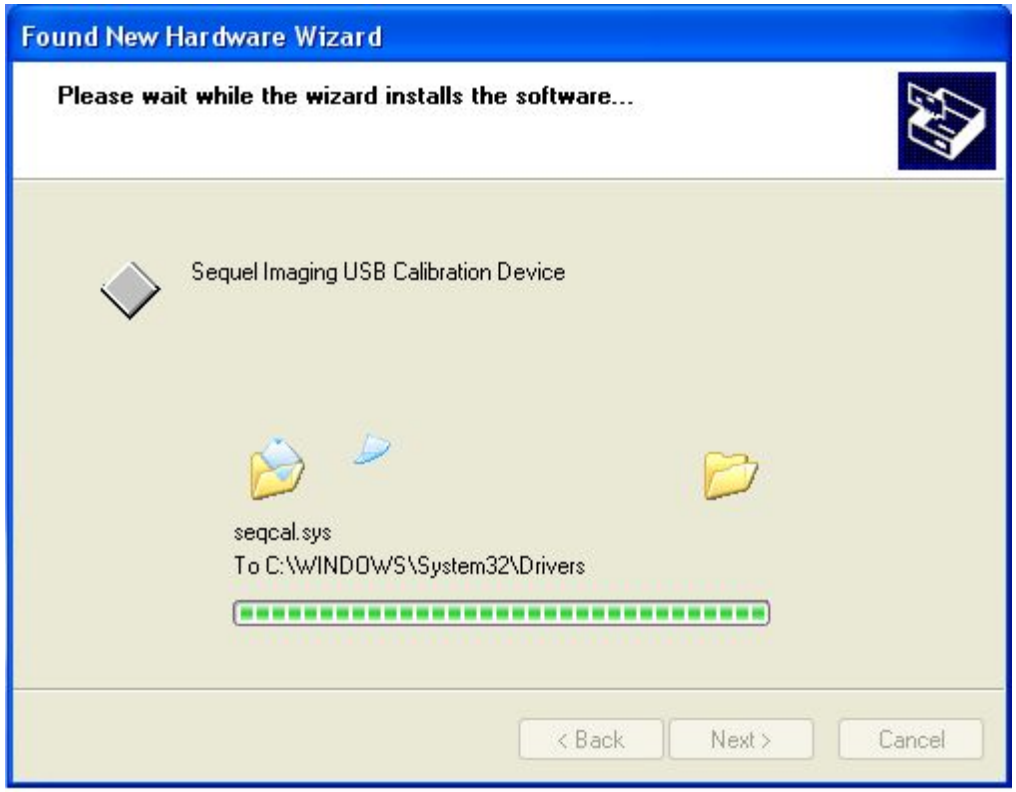
The “Found new Hardware Wizard” will start. Click the “Yes, this time only” radio button followed by “Next”.

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel

Check the “Install the Software Automatically (Recommended)” radio button and click “Next”.

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
This wizard helps you install software for:
Sequel Imaging USB Calibration Device
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

The software is installed automatically.



When all drivers have been loaded and configured, the wizard will prompt you to click on the “Finish” button.

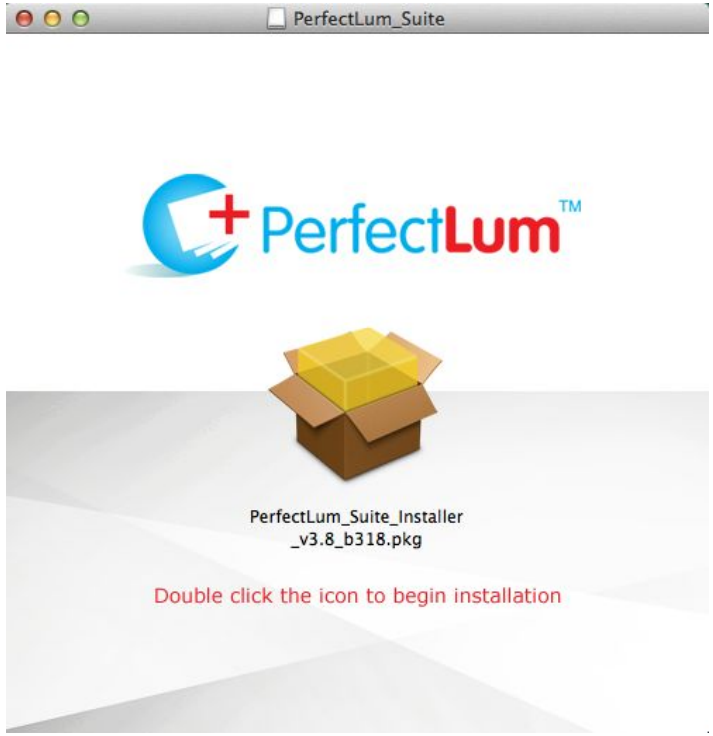
Found New Hardware Wizard
Completing the Found New Hardware Wizard
The wizard has finished installing the software for:
Sequel Imaging USB Calibration Device
Click Finish to close the wizard.
< Back
Finish
Cancel

Windows will notify you when the measurement device is ready to use, by momentarily displaying the “Found New Hardware” message balloon in the lower right corner of the screen.

Mac OS:

Double click on the installer

Proceed by double clicking on the “box”.



Follow the instructions presented in the installer and click on the QUBYX software license agreement after reading it carefully.

Install PerfectLum_Suite
Standard Install on "MacOS 10.9"
Introduction
License
Destination Select
Installation Type
Installation
Summary
This will take 99.8 MB of space on your computer.
Click Install to perform a standard installation of this software for all users of this computer. All users of this computer will be able to use this software.
PerfectLum™
Go Back
Install

Click "Install" to begin the installation.

1.5. The Main Window

Preliminary Conditions:

Before using the software, make sure the following conditions are observed:

- ambient light should be constant;

- ambient light should be as low as possible;

- no direct light should reach the display.

The tasks included in the Main Window:

On the left you can notice a list of displays linked to the PC. PerfectLum Suite provides visual feedback to help identify your display in a multiple head situation. Double clicking on the selected display icon will identify the selected screen.

PerfectLum Suite Main window has 3 Tabs:

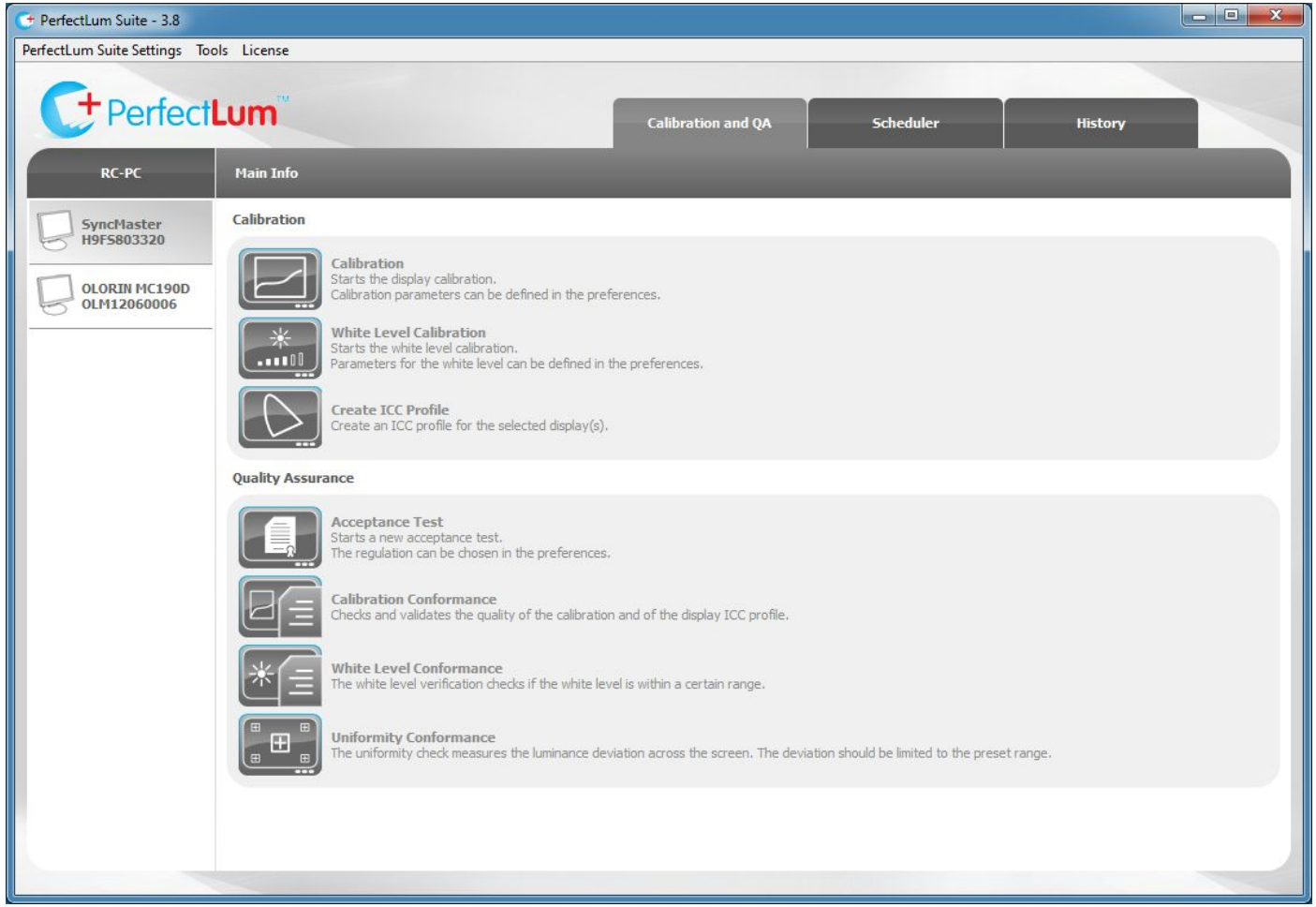
- Calibration and QA Tab. Here you can initiate calibrations and QA tasks.

- Scheduler Tab. Here you can manage your scheduled tasks.

- History Tab. Here you can view history data.

In the center of each tab there are buttons or lists of tasks to access all of the functionalities of the software.

1.5.1. Calibration and QA Tab


PerfectLum Suite - 3.8
PerfectLum Suite Settings
Tools
License
PerfectLum
Calibration and QA
Scheduler
History
RC-PC
Main Info
SyncMaster
H9FS803320
OLORIN MC190D
OLM12060006
Calibration
Calibration
Starts the display calibration.
Calibration parameters can be defined in the preferences.
White Level Calibration
Starts the white level calibration.
Parameters for the white level can be defined in the preferences.
Create ICC Profile
Create an ICC profile for the selected display(s).
Quality Assurance
Acceptance Test
Starts a new acceptance test.
The regulation can be chosen in the preferences.
Calibration Conformance
Checks and validates the quality of the calibration and of the display ICC profile.
White Level Conformance
The white level verification checks if the white level is within a certain range.
Uniformity Conformance
The uniformity check measures the luminance deviation across the screen. The deviation should be limited to the preset range.

Calibration: this function allows you to calibrate your display. The software will adjust your monitor based on your selected preferences. First select the display you want to calibrate from the left menu and then click the “Calibration” button.

IMPORTANT: Calibration should always be started on a warmed-up display. Warm-up time is specified by the display manufacturer (minimum 30 minutes).

White Level Calibration: adjusts the white level of your display to the target luminance in candelas.

Create ICC Profile: creates a LUT - based ICC v4 profile of the display with the selected settings of the chromatic adaptation.

Acceptance Test: this task allows you to perform an acceptance test according to one of the following regulations: AAPM TG18, JESRA X, DIN 6868-57, DIN 6868-157, IEC 62563-1 and NY PDM. The function automatically generates schedules for the corresponding conformance tests. You can view the threshold values for each regulation by clicking the "Show Thresholds" button in QA Settings.

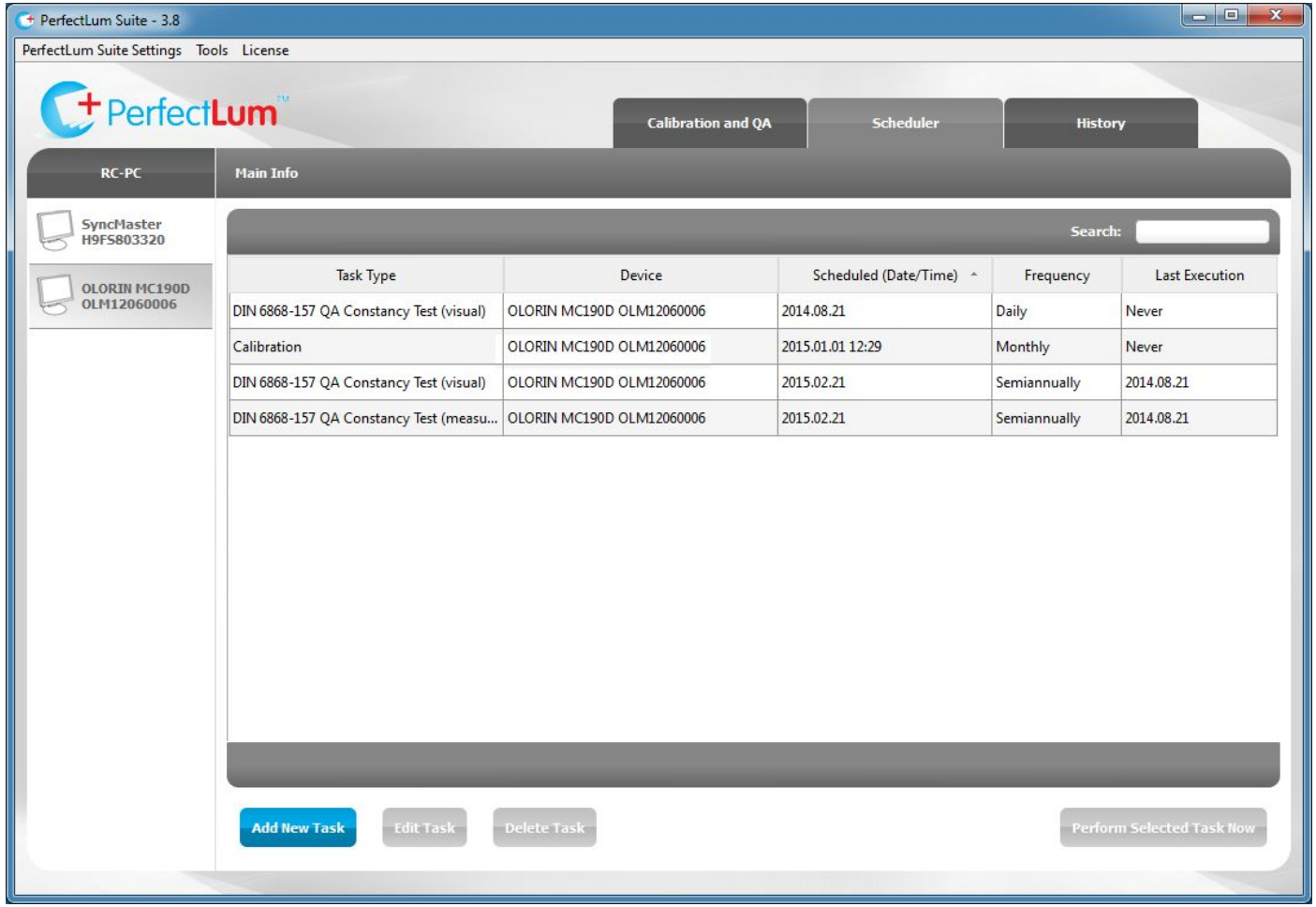
If you have already performed the acceptance test(s), you can import it into PerfectLum with the help of the "Import Acceptance Values" Feature (see section 2.4.2).

Calibration Conformance: The function checks and validates the quality of the calibration and of the display ICC profile according to the preferences you have selected as Calibration targets.

White Level Conformance: verifies the display's luminance level.

All listed above functions (except Create ICC Profile) can also be performed in the demo version, which will be available during 15 days.

1.5.2. Scheduler Tab



In the Scheduler Tab you can see automatically scheduled QA Constancy tasks (depending on the regulation you have selected). It is possible to postpone the scheduled tasks, add, edit and delete locally created tasks.
Constancy test schedules that were created automatically by PerfectLum Suite software can not be deleted. Also, schedules that were created from the system admin panel on the remote server can be edited and deleted only by the system admin.

In order to create a new task click the “Add New Task” button and select the following options: type of task (Calibration, Create ICC Profile, Calibration Conformance, White Level Calibration, White Level Conformance, Display Test Pattern), the display you want to perform the task on, schedule type (Start-up, Once, Daily, Weekly, Monthly, Quarterly, Semiannually, Annually) and the scheduled date and time.

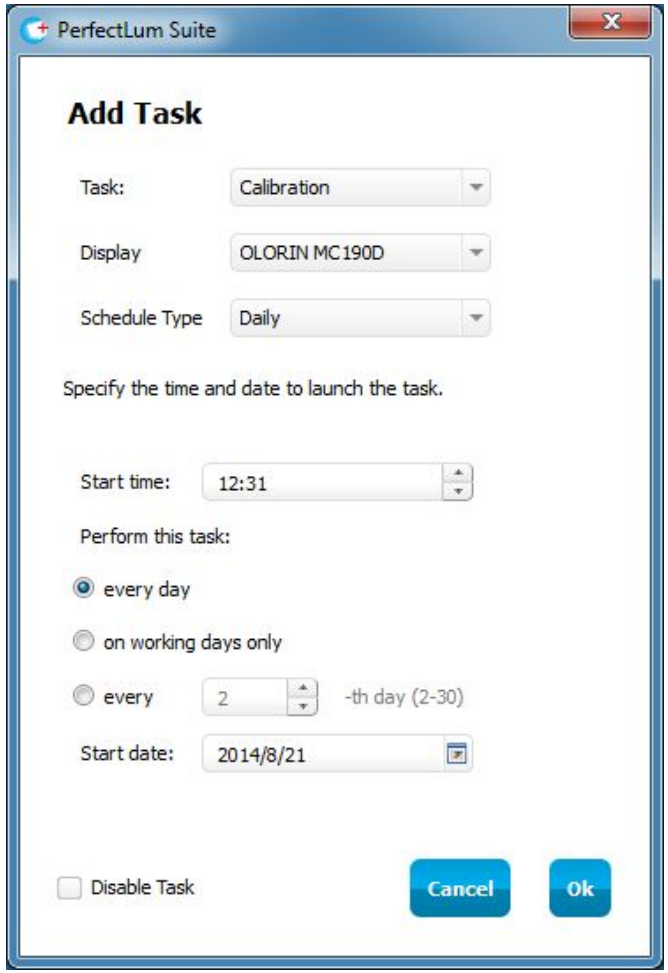
You can also disable tasks - in this case you will not be notified about them by the task notificator. Just check the ‘Disable Task’ box.

To edit a task, select the task, click the “Edit Task” button or double-click on the task.

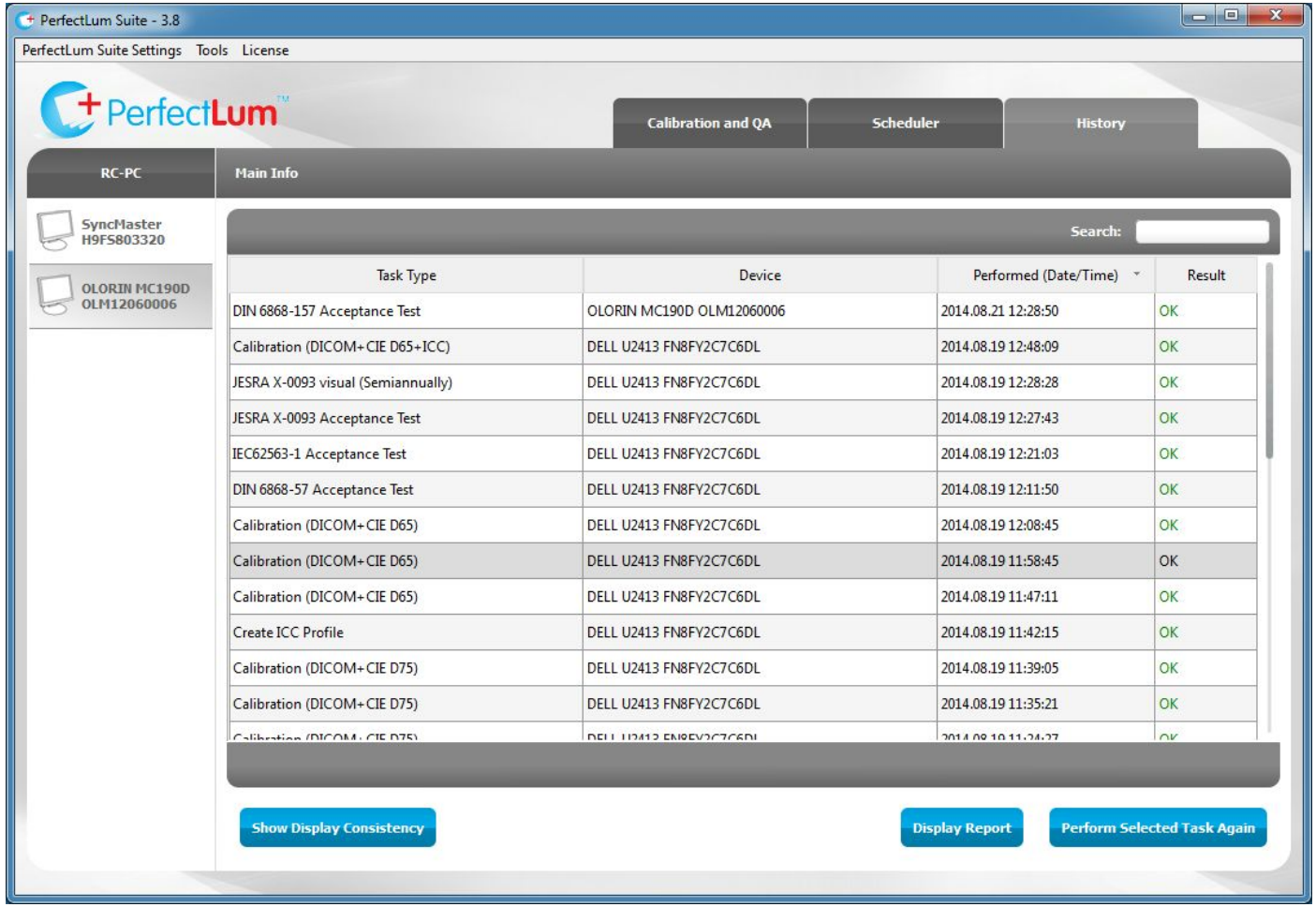
To delete a task, select the task and click on the “Delete Task” button.

To launch a new task instantly, select the task and click on “Perform Selected Task Now”.

In the search field you can filter task types, displays, dates and frequency.



1.5.3. History Tab



In the History Tab you can view tasks that were performed in the past. Simply double-click on a task to see the detailed report.

Select a task from the list and click “Perform Selected Task Again” to restart the task.

The search field enables you to filter task types, displays, dates and results.

The 'Show Display Consistency' function indicates white and black levels of a selected display over time on a graph. The graph is shown when enough data is collected (e.g. 2 or more tasks were performed on a display). Note that the data are shown only for connected displays.

"Display Report" shows the option where you can select a time interval and a display for which you want to see a report of all QA tasks performed.

1.6 Do my first calibration:

First select the display you want to calibrate from the menu on the left. After that, click the "Calibration" button. A Wizard will pop up and will guide you in order to customize the calibration process.
Please note that the Wizard will not pop up if you have opened the preferences before.

IMPORTANT: Calibration should always be started on a warmed-up display. Warm-up time is specified by the display manufacturer (minimum 30 minutes).

Select the calibration type by choosing between DICOM, Gamma, CIE L*, BT.709 and BT.1886.

If you want to calibrate the color of the display, check "Adjust Color Temperature" box, select the predefined target value or enter your own value by choosing a "custom" option.

If you want to adjust the white level, check "Set White Level" box and enter the target white level luminance in candelas.

After you customized the calibration settings, place the sensor on the display and start the calibration process. Make sure no ambient light reaches the sensor. After calibration is finished a report will pop up on the screen with the calibration results.

1.7. Do my first QA Acceptance test:

When you perform the first acceptance test a Wizard will pop up. The Wizard will prompt you to select the regulation and the display category. In addition, you have to fill in some information about the location of your workstation and the responsible person. Please note that the Wizard will not pop up if you have opened the preferences before.

The acceptance test consists of two parts: a measurement part and a set of visual tests. The exact tests are determined by the selected regulation. For measurement tests an on-screen or a handheld measurement device can be used. Please refer to the list of supported measurement devices for detailed information.

After the acceptance test was performed, associated Consistency QA Tasks are automatically scheduled.

II. PREFERENCES:

2.1. Application Settings:

2.1.1. Language:

Set the language of the application. Supported languages: English, German, Japanese, Chinese, Korean, French.

2.1.2. Software Update:

Check the "Update Software Automatically" box if you want the software to notify you about new software updates.

2.1.3. Password Protection:

When you check the "Protect Settings by Password" box two fields will appear. Enter a password in the first field and repeat it in the second field.
IMPORTANT: Make sure you note down the password in a secured location for future use, since you can not recover it from the system.

Once the preferences are protected by a password, they can be changed only when the correct password is entered. If the wrong password is entered, the settings are visible, but can not be changed.

2.1.4. Export/Import Common Settings:

Settings of the application can be exported into one file as backup or as "golden" settings. The same settings can be imported into the application from other machines to work with the same settings and to save time during installations.

To export the settings, click on the "Export" button and browse the directory to select the folder where you want to save the settings.
To import the settings, click on the "Import" button, browse for the .qbxs settings file and click OK.

Please note that the "Display Settings" and the "Remote and Network Settings" will not be recovered. Display settings and serial numbers can differ from each other and the different remote and network settings can be set on different workstations.

2.1.5. Backup/Recover:

This function will back up the entire database with all history data, settings and schedules. Click on the "Backup" button and browse the directory where you want to save the database. Click "Recover" and browse the .qbx database backup file to recover the database.

Please note that the "Display Settings" and the "Remote and Network Settings" will not be recovered. Display settings and serial numbers can differ from each other and the different remote and network settings can be set on different workstations.

Check the "Activate auto backup" box to have the software run an automatic backup every day, week or month. Select the directory where you want the database to be saved.

Note: If the path you've chosen for auto backup is changed (renamed or deleted folder) the path line will become selected with a red frame - choose a correct path for auto backup and save preferences.

2.2. Workstation Settings:

2.2.1. Workstation Name:

The workstation name is read automatically from the system. It can be overwritten to be personalized.
The workstation name can be changed and is used on the remote management server to identify your workstation among the others.

2.2.2. Ambient light:

Ambient Light is the reflection of ambient light on the switched off display panel. Enter a value for ambient light in candelas if you know it, or click the "Measure Ambient Light" button to measure the reflection. During this process the software will switch off the backlight of the panel. You must place the sensor 15 cm away from the display facing the switched off panel. The software will measure the reflection of an ambient light on the display panel.

During the measurement process don't move the mouse and don't hit any keys as it will switch the display back on. Once the measurement is finished the display will be automatically switched back on.

2.2.3. Task Delay:

Check the "Use Scheduler to remind me when Tasks are due" box to program the application to automatically remind you when a task is due. This function can also schedule start tasks automatically. Set the time between 5 and 60 minutes for the display to warm up after the system boot before starting any scheduled tasks.

2.2.4. Sleep Mode:

Check the"Put display to Energy Saving Mode" box to put the display into an energy save mode for a set time period. In the energy save mode the backlight of the display is switched off to save energy and to extend backlight lifetime.

2.3. Calibration Settings:

2.3.1. Calibration Type:

DICOM	Calibrates to NEMA DICOM Part 14 GSDF (Grayscale Display Function)
Gamma	Calibrates towards the gamma function. Enter a value for gamma. Typically Gamma 2.2 is used.

CIE L*	Calibrates to the Color Space Lab of the CIE (Commission Internationale d'Eclairage)
BT.709	Defines the image format parameters and values for HDTV, specifies the opto-electronic transfer characteristics at the source.
BT.1886	Specifies the reference electro-optical transfer function that the displays used in HDTV programme production should follow in order to facilitate consistent picture presentation.

2.3.2. Color Temperature:

Check the "Adjust Color Temperature" box to calibrate the color of the display and to adjust the display to reach target color temperature. You can enter the target color temperature in 3 different ways:

CIE Standard light source color presets	Standard lights between D50 and P93. D65 is the mostly used value and represents daylight.
Color Temperature	Enter a value for color temperature. Color temperature is less precise and doesn't represent a standard like CIE standards.
Advanced settings x and y value	Enter the x and y coordinates of the CIE xyY color space. The values are generally used to match any other device or film.

2.3.3. Gamut:

Check the "Adjust Gamut" box to include a Gamut calibration into the calibration process. Select the predefined color space or enter your own by clicking the "Advanced" button.

2.3.4. White Level:

Check the "Set White Level" box to adjust the white level luminance of the display to a certain value. Enter the target value in candelas

into the field.

2.3.5. Black Level:

Check the “Set Black Level” box to adjust the black level luminance of the display to a certain value. Enter the target value in candelas into the field.

2.3.6. ICC/ICM Profile:

If you want to include an ICC Profile creation into the calibration process, check the “Create ICC/ICM Profile” box and select the necessary chromatic adaptation.

2.4. QA Settings:

All information related to the Quality Assurance Regulations is entered in this section.

2.4.1. Regulation:

Select the Regulation you want to use and the Application Category.

Regulation	Category	Application
DIN 6868-57	Mammography	Mammography
	A	Diagnostic
	B	Reviewing
	Dental	Dental
DIN 6868-157	Projection Radiology	Projection Radiology

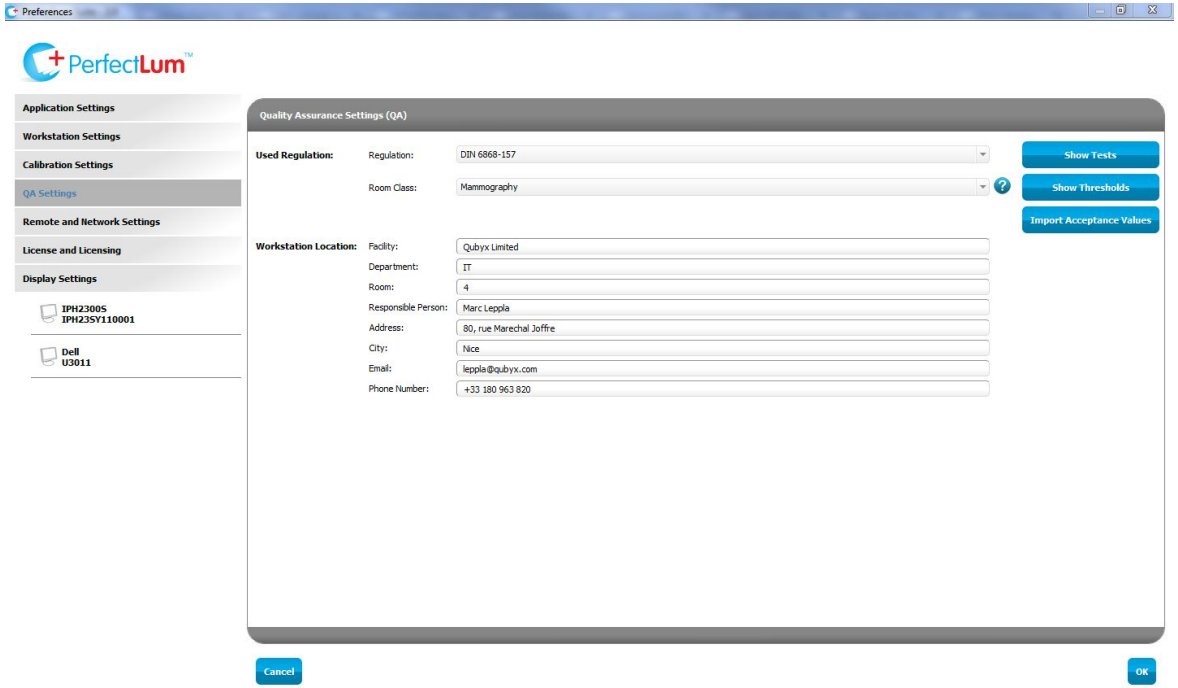
	Fluoroscopy	Fluoroscopy
	Computer Tomography	Computer Tomography
	Dental	Dental
	Mammography	Mammography
	Operation Room	Operation Room
AAPM TG18	Primary	Diagnostic
	Secondary	Reviewing
JESRA X-0093	Category 1	Diagnostic
	Category 2	Reviewing
IEC 62563-1	Diagnostic	Diagnostic
	Reviewing Monochrome	Reviewing
	Reviewing Color	Reviewing
NY PDM	Mammography	Mammography
	No Mammography	Diagnostic

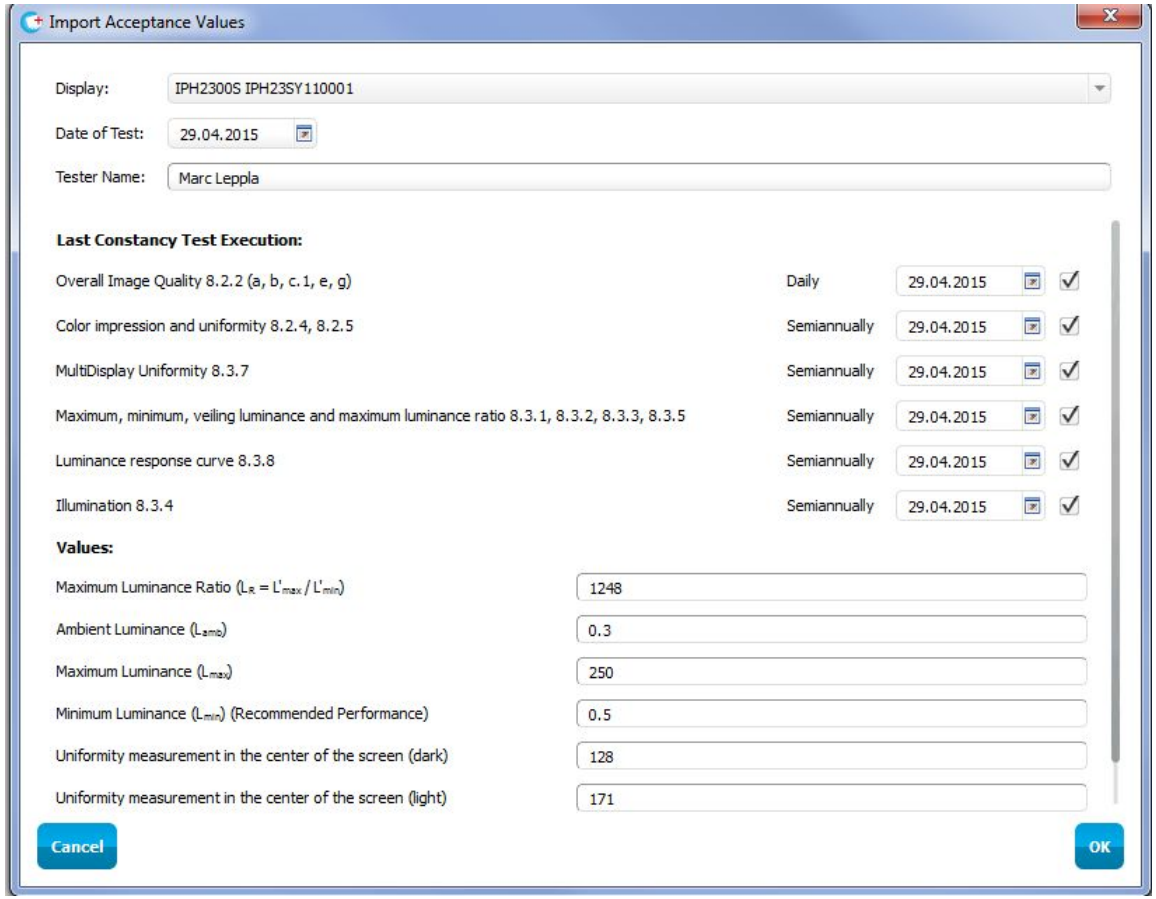
Click the “Show Tests” button to see QA tests that are part of this regulation.
Click the “Show Thresholds” button to see the thresholds that will be applied during QA tests for this regulation and category.

2.4.2. Import Acceptance Values

Easily import all your previously performed QA tests into PerfectLum with the “Import Acceptance Values” feature. In order to use this function, please go to Preferences -> QA Settings, select the desired regulation and click the “Import Acceptance Values” button.

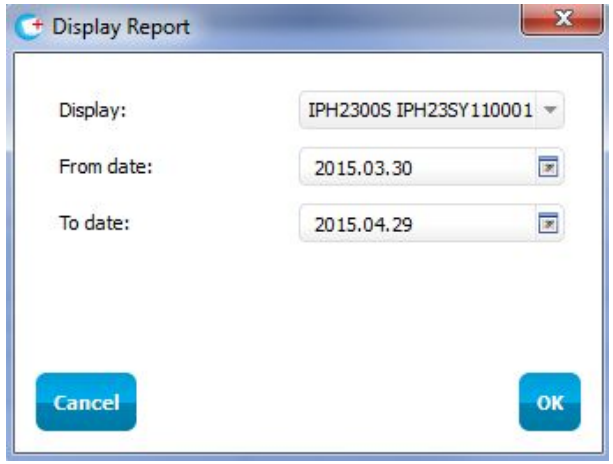
Then select a display, date of the test and a name of a tester who performed the test. If the constancy tests have been passed, please set the dates they were performed and check the appropriate boxes. After you have entered the values measured in the imported test(s), click “OK” and wait until the confirmation message appears.




Import Acceptance Values
Display:
IPH2300S IPH23SY110001
Date of Test:
29.04.2015
Tester Name:
Marc Leppla
Last Constancy Test Execution:
Overall Image Quality 8.2.2 (a, b, c.1, e, g)
Daily
29.04.2015
Color impression and uniformity 8.2.4, 8.2.5
Semiannually
29.04.2015
MultiDisplay Uniformity 8.3.7
Semiannually
29.04.2015
Maximum, minimum, veiling luminance and maximum luminance ratio 8.3.1, 8.3.2, 8.3.3, 8.3.5
Semiannually
29.04.2015
Luminance response curve 8.3.8
Semiannually
29.04.2015
Illumination 8.3.4
Semiannually
29.04.2015
Values:
Maximum Luminance Ratio ($L_R = L'_{max} / L'_{min}$)
1248
Ambient Luminance (L_{amb})
0.3
Maximum Luminance (L_{max})
250
Minimum Luminance (L_{min}) (Recommended Performance)
0.5
Uniformity measurement in the center of the screen (dark)
128
Uniformity measurement in the center of the screen (light)
171
Cancel
OK

In order to view a display report, you need to complete the following steps:

1. Open the “History tab” in the main window of PerfectLum
2. Click the “Display Report” button
3. Select the display for which you want to get a report
4. Set the time interval and click “OK”.



Now you have a report with clear pass/fail indication of test results

Acceptance Test

Test Name	2015.04.29 Marc Leppla
Overall Image Quality 8.2.2 (a, b, c.1, e, g)	Passed
Overall Image Quality 8.2.2 (c.2)	Passed
Overall Image Quality 8.2.2 (d)	Passed
Image Geometry 8.2.7	Passed
Grayscale resolution 8.2.3	Passed
Color impression and uniformity 8.2.4, 8.2.5	Passed
Visibility of line structures in the test pattern TG18-LPH10 8.2.9	Passed
Visibility of line structures in the test pattern TG18-LPH50 8.2.9	Passed
Visibility of line structures in the test pattern TG18-LPH89 8.2.9	Passed
Visibility of line structures in the test pattern TG18-LPV10 8.2.9	Passed
Visibility of line structures in the test pattern TG18-LPV50 8.2.9	Passed
Visibility of line structures in the test pattern TG18-LPV89 8.2.9	Passed
Clinical Reference Images 8.2.8	Passed
Pixel Errors 8.2.6	Passed
Pixel Size 8.4-8.5	Passed
Display Resolution 8.4-8.5	Passed
Luminance Uniformity 8.3.6	Passed
MultiDisplay Uniformity 8.3.7	Passed
Maximum, minimum, veiling luminance and maximum luminance ratio 8.3.1, 8.3.2, 8.3.3, 8.3.5	Passed
Luminance response curve 8.3.8	Passed
Illumination 8.3.4	Passed

Note:
If you want to exclude the specific QA or Constancy tests data from the display report, you can click the right button on them in the “History tab” and select the “Disable” option.

2.4.3. Workstation Location:

The workstation location contains the information about the workstation used to perform the tasks (e.g. Display Calibration, QA). Please enter the information regarding your facility, department and room.
Note: this information will be displayed in reports.

2.4.4. Person Responsible:

The person responsible is the person who should be notified if something is wrong with the workstation. Please enter the information into the corresponding fields.

2.5. Remote and Network Settings:

Activate Remote Control for the workstation and connect it to the PerfectLum Remote Control server.

2.5.1. Enable Remote:

Enter the IP address or the server address like https://remote.qubyx.com into the field "Server Address". Enter the username and the password of the PerfectLum Remote user account and click the "Enable Remote Management" button. When connection is established, a dialog will pop up, asking you to select the workgroup for this workstation. Select the workgroup and click 'Save' - then all the data (schedules, history and preferences) will be immediately synchronized with the remote server.
Note: Remote Admin account needs to be created first on PerfectLum Remote. In addition to this, you have to create a workgroup, a facility and user accounts on Remote Server in advance.

2.5.2. Remote Database Synchronization:

Select the time interval within which you want to synchronize the databases between the client and the server.

2.5.3. Your Proxy Server:

Check the "Use Proxy" box if you use a proxy server to access the internet. This action is required in order to access PerfectLum Remote Management server if you do not use it on the intranet and for activating software license automatically via internet.
Note: If the "Use Proxy" box is checked, the license activation will be performed using the given settings.

III. LICENSE AND LICENSING:

3.1. Remote License:

Remote license is included for FREE. You can connect and manage your displays with QUBYX PerfectLum Remote server. The following features are also free: Calibration Conformance, White Level Conformance, Display Test Pattern, Measure color.

3.2. PerfectLum Suite License:

PerfectLum Suite license is required to perform Calibration and White Level Calibration, QA Acceptance and Constancy tests for AAPM TG18, JESRA X, DIN 6868-57, DIN 6868-157, IEC 62563-1 and NY PDM regulations. In order to activate the license, click the "Add License" button, enter the license code and your email address into the selected fields and click "Activate". The license will be activated if your workstation is connected to the internet. If it is not connected, go to http://qubyx.com/index.php/register from any other machine and enter the license code and the ID number from the workstation (visible in the license activation window). You will receive an unlock code. Enter this code into the activation window to activate and unlock the software.

IV. DISPLAY SETTINGS:

The displays connected to the workstation are visible in separate tabs. Select a display to adjust the settings for that specific display.

4.1. Ignore Display:

Check the "Exclude Display from Testing/Calibration" box if you do not want to perform any Quality Assurance tests or calibration on a specified display.

4.2. Calibration Upload:

Calibration upload will select the location where LUT (Look Up Table) will be saved and the exact communication channel that will be used to perform the action.

Note: Calibration upload is detected automatically for each display.

Calibration Upload	Look Up Table is saved in	Used communication channel
Graphics card	Graphics card	Graphics card
DDC/CI	Display	DDC/CI i2c channel
Serial	Display	Serial RS232
USB	Display	USB

4.3. Used Sensor:

Check the "Use Internal Sensor If Possible" box if your display has an internal Front Sensor and you want to use that sensor during calibrations.
Note: The sensor is detected automatically for each display. If this option is missing, that means your display has no Front Sensor available.

4.4. Display Model:

The software will read the model name of the display from its EDID. You can change the model name. The model name will be visible in calibration and QA reports.

4.5. Display Serial Number:

The software will read the serial number of the display from its EDID. You can change the serial number. The serial number will be visible in calibration and QA reports.

4.6. Display Manufacturer:

The software will read the name of the display manufacturer from its EDID. You can change the name. The manufacturer's name will be visible in calibration and QA reports.

4.7. Inventory Number:

You can set an inventory number for the display.

4.8. Type of Display:

Select the type of the display (Color or Gray). Depending on your choice, a different calibration algorithm and a different set of QA tests will be used for this display.

4.9. Display Technology:

Select if the display is a Flat screen, LCD or a CRT screen. Depending on your selection different thresholds in QA regulations will be applied.

4.10. Screen Size:

The software will read the diagonal size of the display automatically.

4.11. Resolution (h/v):

The software will read the horizontal and vertical resolution of the display automatically. The resolution will be documented in QA reports.

4.12. Backlight Stabilization:

Select if the display has integrated backlight stabilization that maintains the white level of the display constant over time. If the display has backlight stabilization the intervals for QA test will be longer.

4.13. Installation Date:

Enter the date when the display was installed.

V. REGISTRATION

5.1. Free and Additional Features:

PerfectLum has free and additional features. Free features are available as soon as you install PerfectLum. Additional features can be unlocked by buying the display calibration and QA license.

Free features	Additional features
Calibration Conformance	Display Calibration
White Level Conformance	White Level Calibration
Display Test Pattern	QA Acceptance Tests
Measure Color	QA Constancy Tests
Sync with remote	Create ICC Profiles
3D Gamut Viewer	
History and Reporting	
Task Scheduling	

There are two possibilities to access the licensing part: over Preferences or License section from the main window.

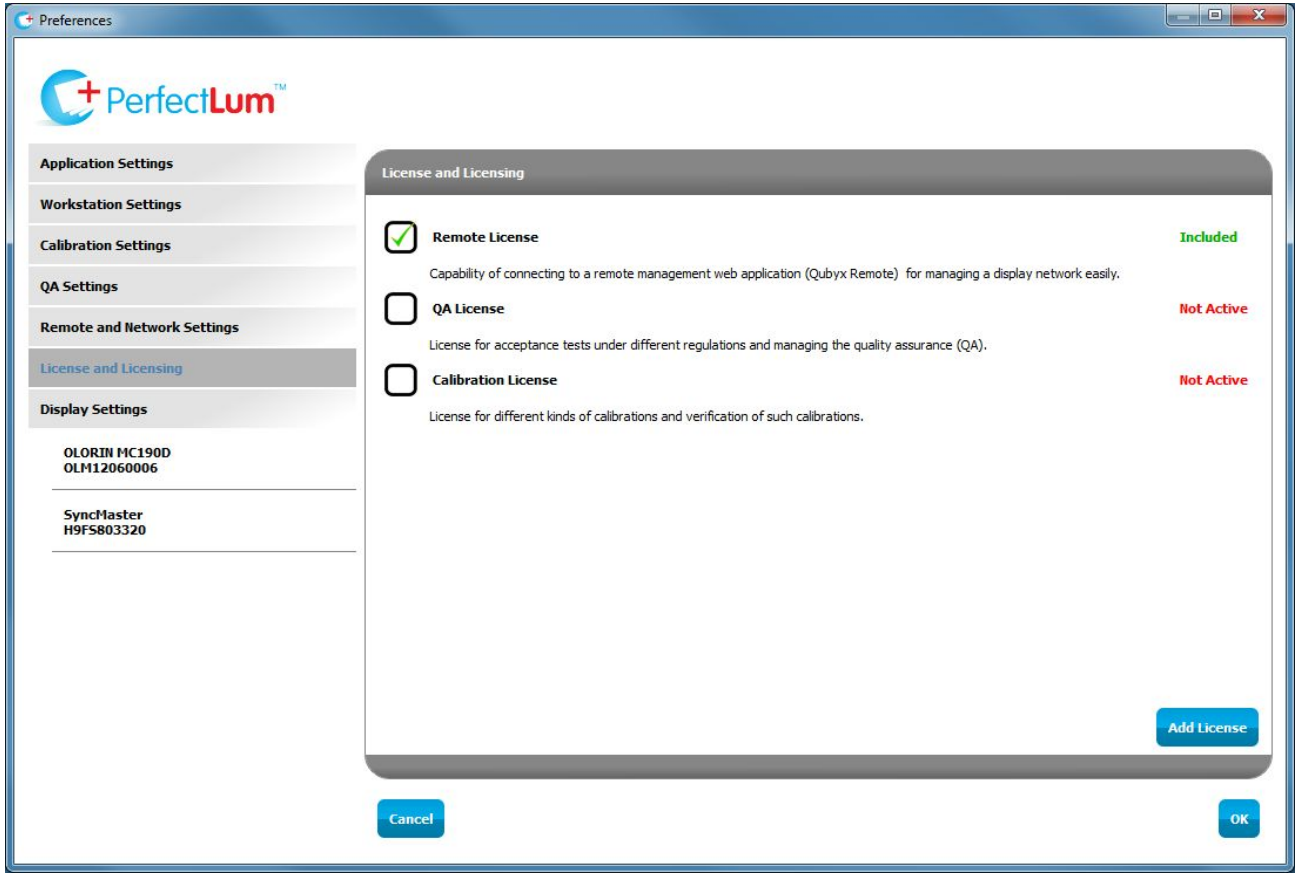
5.2. Licenses Functionality

Function	PerfectLum Suite	PerfectLum Suite Demo Period	PerfectLum Suite Expired Demo Period
Calibrate Display	+	+	-
Hardware calibration and DDC/CI / USB / Serial usage	+	-	-
Adjust White Level	+	+	-
Verify calibration	+	+	+
Verify White Level	+	+	+
Generate Display ICC Profile	+	-	-
Adjust Gamut	+	-	-
Perform Acceptance Test	+	+	-
Perform Constancy Tests	+	-	-
Schedule QA Tasks	+	+	+
Edit Settings	+	+	+
Edit Calibration Settings	+	+	+
Edit QA Settings	+	+	+
Measure Color	+	+	+
Display Test Pattern	+	+	+
Remote Control	+	+	+

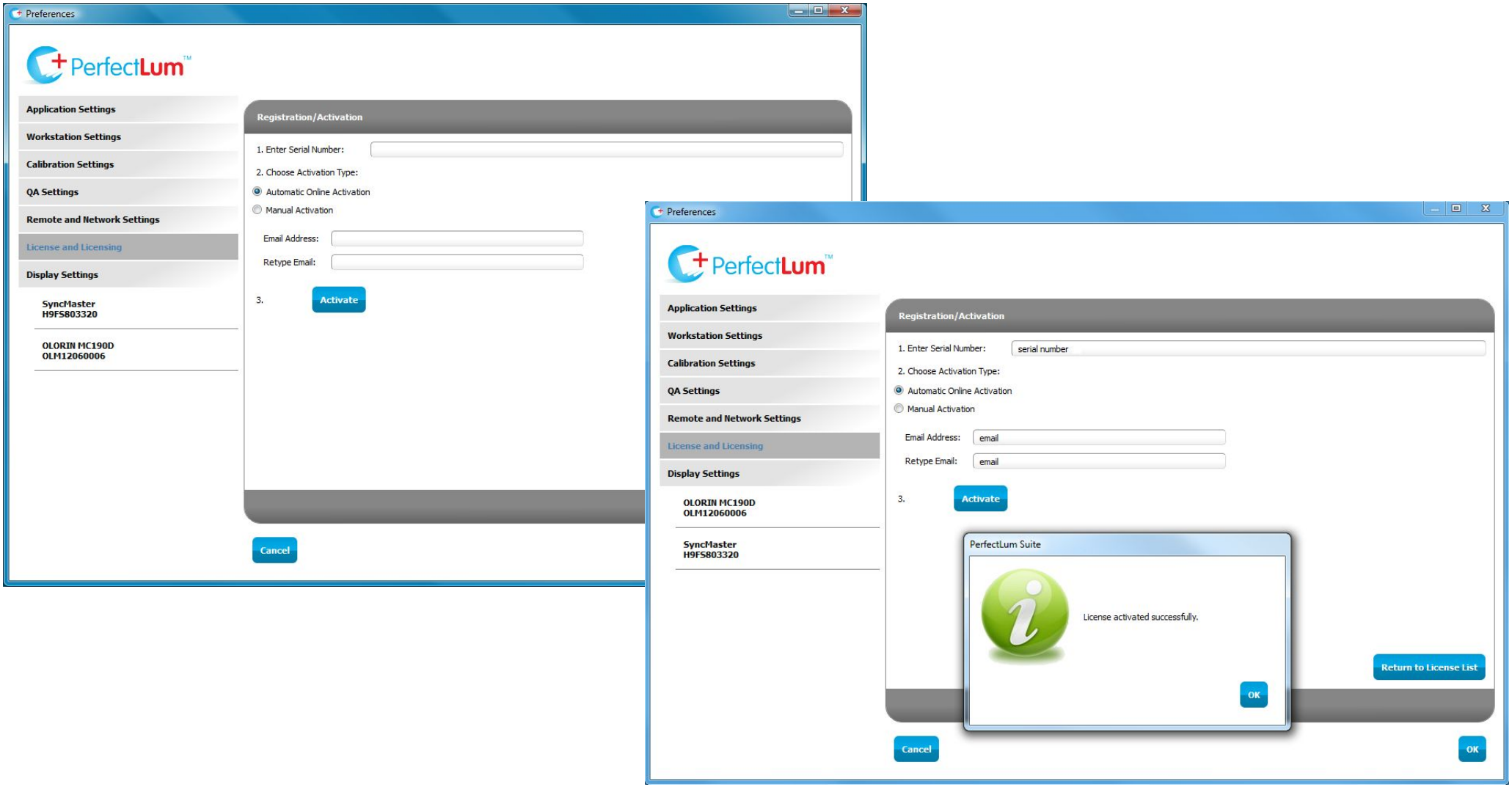
Note: Quick access to preferences is Ctrl+P for Windows or Command+P for Mac OS X.

5.3. License Activation

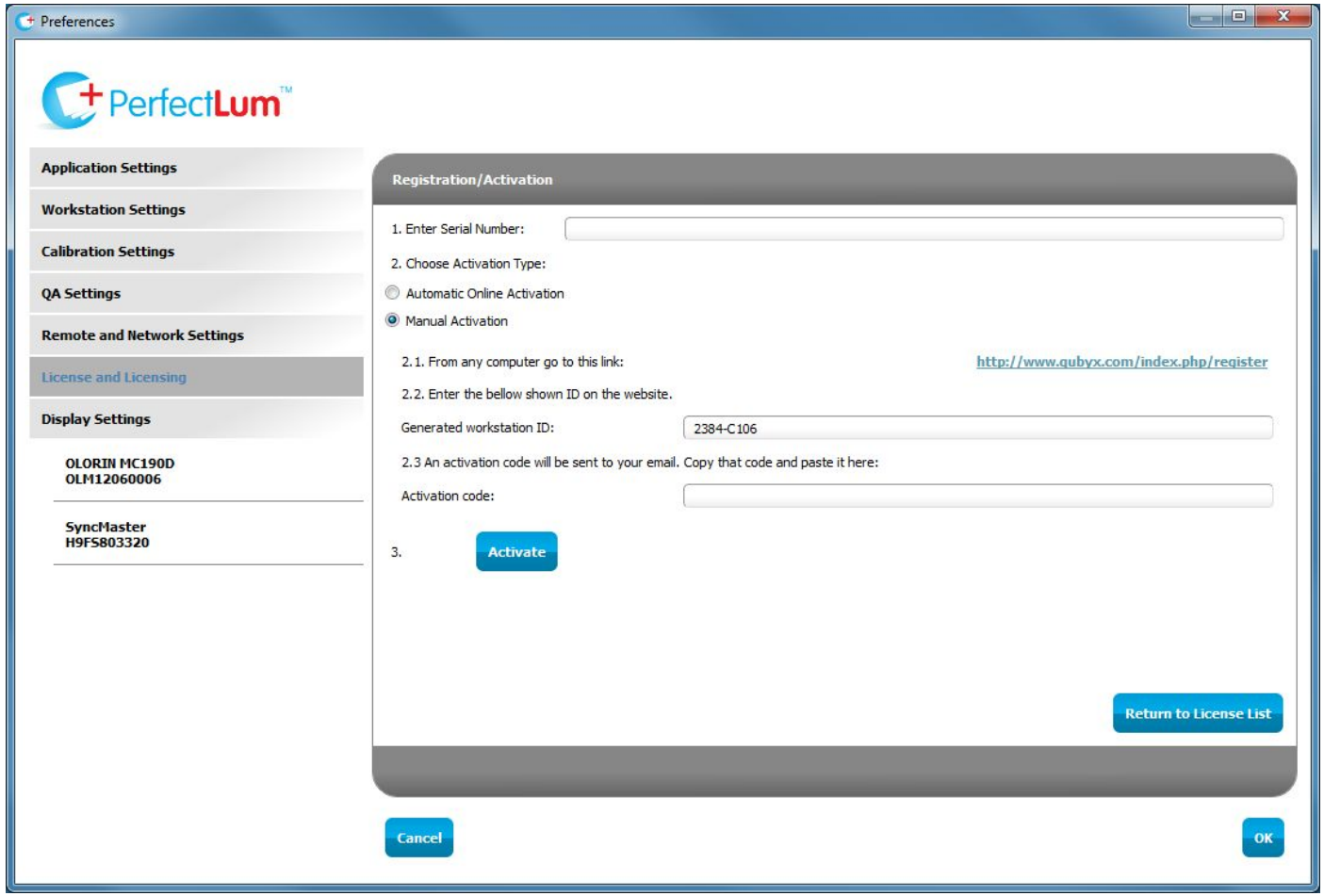
To activate the Calibration and QA license, click the “License” option in the main window, and select “Registration/Activation”. When the Registration/Activation window opens, enter the serial number you obtained when you purchased a license, and choose an activation type.



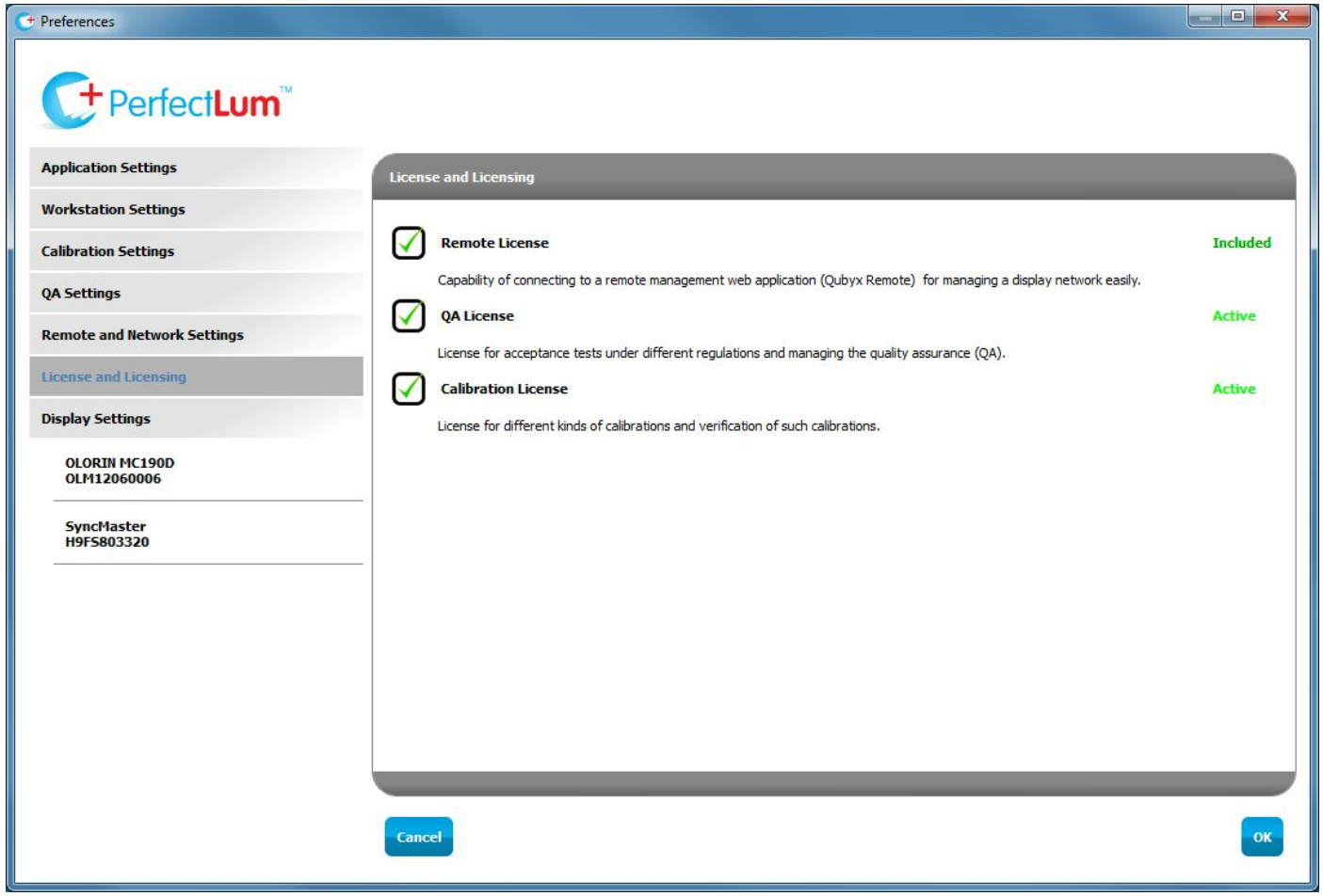
For automatic online activation, just enter and repeat your e-mail address, and click the “Activate” button.



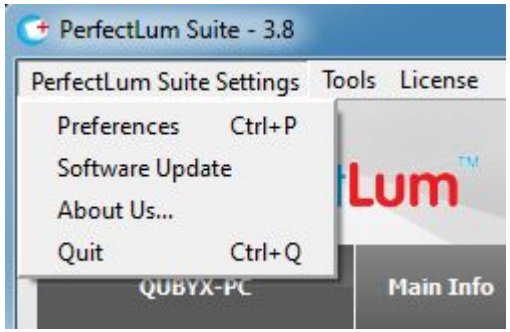
For manual activation, follow the link and fill out the form that you will find on the website. Enter the generated workstation ID that you see below into the corresponding field of the form. When you submit the form, an activation code will be sent to your e-mail. Enter this code into the field below and click “Activate”.



When you finish the license activation, all licenses in the Preferences > License and Licensing section will be marked as active.



VI. PERFECTLUM SUITE MENU ITEMS:



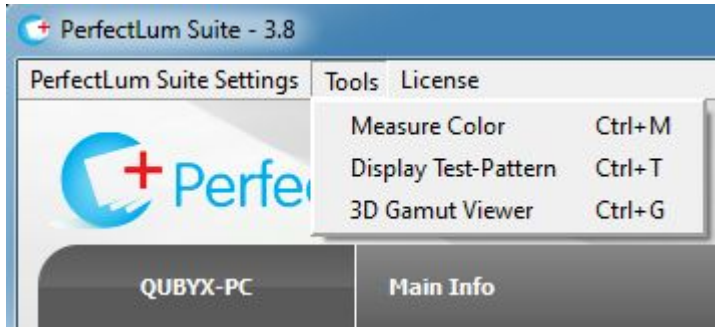
6.1. Software Update

This function checks the server for a new PerfectLum Suite version. You will get a link to download a new version if there exists one.

6.2. About Us...

The window where you can see our contact information, license agreement, license information and version installed.

Tools:



Tools are accessible in PerfectLum Suite from the Main Window > Tools

Note: Tools are included for free use.

6.3. Measure Color:

This function will open two windows. In the first window you can start measurement. Mix color and gray levels will be displayed in the second window where measurements are actually performed. First select the RGB color patch with sliders or by entering a number for RGB values. Then place the measurement device on the patch and start measuring. You can perform two measurements, the software will compare them and will display color difference in Delta E with or without L (Luminance).

Note: Quick access to this tool is Ctrl+M (Command+M on MAC OS)

6.4. Display Test-Pattern:

Select the display where you want the test pattern to be displayed and select the test pattern you want to display. Click "View and Check". For displaying a test image that is not in the list, but is available on the system, select "User Image" click View and Check, navigate to your image file and open it. Click on the test pattern or press "Escape" button on your keyboard to close it.

Note: Quick access to this tool is Ctrl+T (Command+T on MAC OS)

6.5. 3-D Gamut Viewer:

This function graphically displays the 3D gamuts of different profiles using the selected color spaces and rendering intents. It is possible to calculate the percentage of Gamut intersection of two profiles.

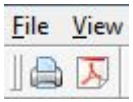
6.6. Notification:

After a task is created, PerfectLum Suite Task Notification will pop up at the scheduled time provided that the warm up time has expired (see "Use Scheduler to remind me when Tasks are due"). Click the "Perform Scheduled Tasks"' button to carry out a scheduled task or

"Remind Me In" button to remind the user about the task later. You can also choose the time interval of getting a reminder in the combo box placed near. Closing this window means "Remind Me In" + value that is set in the combo box.
Note: For displays that have Front Sensors, measurement tasks that require no manual interruption (Display Calibration, Display Conformance, White Level Calibration, White Level Conformance and Create ICC Profile) will be started automatically and report will not be shown for the next task to start successfully.

6.7. Report:

After each measurement and QA task you will get a report where you can check your result with more details and graphs, and a summary result (OK or Failed). Reports can also be exported as a .PDF file or printed. Use these two icons:



VII. OTHER

7.1. Matching Multiple Displays

To achieve identical image reproduction on two or more displays connected to one workstation side by side, or several displays connected to different workstations, you will need to adjust such characteristics of the displays as color temperature, white level, and luminance response to the same level.

To match image reproduction on two or more displays, follow this procedure:

1. Make sure all displays are set to the same values over the display OSD. Especially important are the color pre-settings, brightness, and the contrast settings. Doing a factory reset on all displays can be helpful to make sure all of them start from a similar level.
2. Use only one measurement device. Measurement devices, unfortunately, still have considerable deviations when measuring color. So it is recommended to use the same device on all displays.
3. Identify the weakest display. If you want all displays to have the same white level, you need to know which of them has the lowest one and measure it. This white level will become the target value for all displays. It is important to have the same white level on

displays that are connected to one workstation and installed side by side.

4. Set your target values for white level, color temperature and luminance response in PerfectLum Preferences.
5. Perform a display calibration with those same settings on each of your displays.

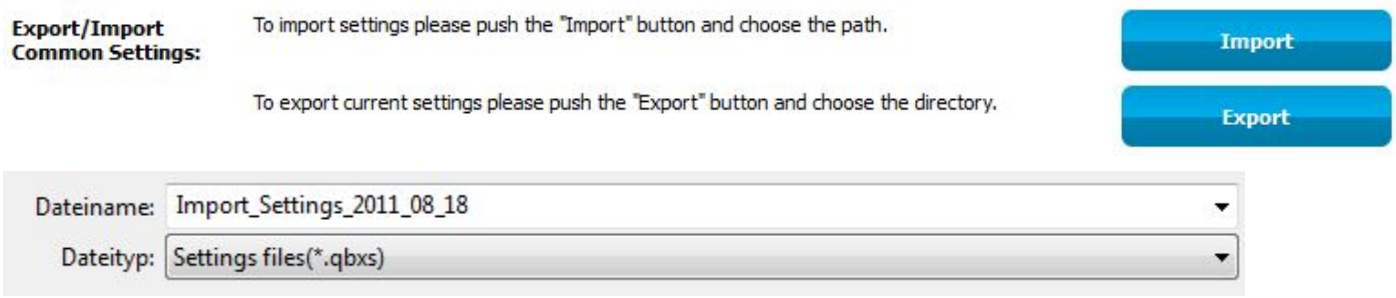
7.2. Read Me - mass installation of PerfectLum Suite version 3

Create your “master” settings file

Before performing a mass auto-installation you need to prepare your “master” settings file.

To do this just make ONE usual installation and set all needed configurations in preferences. (**Important:** Do not forget eventual proxy settings if they are used in your network).

Then go again to Preferences > Application and click “Export”. The software will create the needed file for auto-configuration. The file extension is .qbxs - save the file in your preferred location.



Installation

On every workstation you will need to:

1. Copy the PerfectLum Suite installer msi file and the “master” settings file (.qbxs file)

2. In console run installation in silent mode (you MUST have administrative rights):

msiexec /i [PATH to installer]PerfectLum_Installer.msi /quiet

or if you need specific installation path:

msiexec /i PerfectLum_Installer_v3.0.436.msi /qn INSTALLDIR=D:\Apps\Qubyx\PerfectLum3

Warning: the installation will not be completely silent - import of PerfectLum2 database will appear for a few seconds. Also the user might be asked to apply drivers installation.

run auto configuration:

[PATH]perfectlum.exe configure <PATH-to-Settings> [<PATH-to-Log>]

Examples:

"C:\Program Files\Qubyx\PerfectLum3\perfectlum.exe" configure default.qbxs

"C:\Program Files(x86)\Qubyx\PerfectLum3\perfectlum.exe" configure default.qbxs d:\logs\p3log.log

"D:\Apps\Qubyx\PerfectLum3\perfectlum.exe" configure d:\tmp\default.qbxs d:\logs\p3log.log

run auto registration:

[PATH]perfectlum.exe registration <SERIAL> <MAIL> [<PATH-to-Log>]

Example:

"C:\Program Files\Qubyx\PerfectLum3\perfectlum.exe" registration 012XERT2ASDF admin@hospital.co.uk d:\logs\p3log.log

run auto remote enabling:

[PATH]perfectlum.exe remote <SERVER> <LOGIN> <PASSWORD> <GROUP_NAME> [<PATH-to-Log>]

Example:

"C:\Program Files\Qubyx\PerfectLum3\perfectlum.exe" remote "http://remote.perfectlum.com" testuser testpassword "our group"

d:\logs\p3log.log

Notes:

<PATH-to-Log> - is an optional parameter in all commands

<GROUP_NAME> - is the name of a workgroup you want to connect your machine to. Case insensitive, but sensitive to the whitespaces

7.3. PerfectLum Remote: System Administrator Guide

System Requirements

Virtual Machine (VM) is provided as an OVA package. So, you need virtualization software, which supports OVF (Open Virtualization Format) and .vmdk disk images. Oracle VirtualBox is the preferred choice for running this VM. However, you can also use VMware products.

About 550 Mb of free space is needed for an OVA package and minimum 2 GB needed for VM production use (1.5 GB base system and 500 Mb for database and backups). Note that database and backup images are constantly growing, so you may consider having more free space in advance.

1. Installing and configuring VM

You should use the "Import Appliance" option from the "File" menu of Oracle VirtualBox Manager in order to install VM. All required settings are predefined. However, you may tune some settings, such as amount of memory, to better fit your requirements. We recommend to select the correct network card in virtual machine settings (network tab) before the first start.

After successful installation you may safely start VM. You may log into console when the login prompt appears. You need to do this in order to check or set up an IP address for VM.
It takes IP address via DHCP by default, but you may want to set a static one.

2. TCP/IP Settings

In order to find VMs current IP address you need to complete following steps:

1. Log in as root (find passwords in “Default Settings” document).
2. Run “ifconfig” command and find “inet addr” for eth0 interface in its output.

Now, when you know the IP address of VM, you may use it to log in via SSH or Webmin. Note, that “root” user is not allowed to log in via SSH, so you should log in as “perfectlum” and then use “su” command with a root password.

In order to set a static IP address or change other network configuration settings you should modify “/etc/network/interfaces” file. You can find a full description of “interfaces” file in “Network Configuration” article from Debian (http://wiki.debian.org/NetworkConfiguration#Setting_up_an_Ethernet_Interface).

The alternative way recommended by us is to change system and network settings is Webmin (check Default Settings document for Webmin URL). You may change boot-time network settings by selecting “eth0” interface at “Network Interfaces’”section of “Networking -> Network Configuration” menu.

Both “console way” and “Webmin way” are described for next tasks.

3. Configuring firewall

VM comes up with small set of predefined rules, which are stored at “/etc/iptables/rules” file and executed at boot-time. In order to modify these rules you should edit firewall initialization script “/home/perfectlum/bin/perfectlum-firewall” and then execute it. However, you may edit “/etc/iptables/rules” directly or via Webmin, but “perfectlum-firewall” script is the recommended way to update firewall rules.

Console

```
# nano /home/perfectlum/bin/perfectlum-firewall
```

Modify firewall rules and save changes

```
# /home/perfectlum/bin/perfectlum-firewall
```

Webmin

Use “Linux Firewall” option of “Networking” menu.

4. Mail delivery settings

You may want to provide an SMTP server address if you want to receive email notifications from PerfectLum Remote Management. The only way to do this is updating the Exim configuration. Exim is the MTA (Mail Transport Agent) software, which is responsible for mail delivery.
Open “/etc/exim4/update-exim4.conf.conf” file in a text editor and set “dc_smarthost” directive value to your SMTP server IP-address or hostname. If your SMTP server uses a non-default port you may define it using “::” (two colons). Example:

dc_smarthost=’smtp.googlemail.com::587’

If your SMTP server requires authentication, you should define credentials in the “/etc/exim4/passwd.client” file. To do this just open “/etc/exim4/passwd.client” in a text editor and add a new line with your credentials using the following format: smtp_server:login:password. Example:

smtp.googlemail.com:perfectlum@example.com:examplepassword

When all changes are done you should run the “update-exim4.conf” script to generate new configuration files and then restart Exim.

Console

```
# nano /etc/exim4/update-exim4.conf.conf
```

Modify configuration files according to your needs

```
# nano /etc/exim4/passwd.client
```

Write credentials here if your SMTP server requires authentication

```
# update-exim4.conf
# /etc/init.d/exim4 restart
```

Webmin

There is no possibility to do this in Webmin

5. Managing backups

VM is doing automatic database backups every night. Backup starts right after the midnight. Backups older than 7 days from the current date are removed automatically.
Backups are stored at "/home/perfectlum/backups" in a separate disk image. So, you can even attach a physical partition or hard drive, if you need more space for backups.
You may use "perfectlum-restore" script to restore database backup for particular date. Be careful, because "perfectlum-restore" overwrites your current database.
To restore database backup just run "perfectlum-restore" with full path to backup the file you want to restore.

Example:

```
/home/perfectlum/bin/perfectlum-restore /home/perfectlum/backups/2011-01-01-perfectlum-mysql-backup
```

Don't forget to restart MySQL when restore is finished. Simply run the following command:

```
/etc/init.d/mysql restart
```

Default Settings

Default System Accounts

System Administrator account

Login: root
Password: vb903lejfMPk1

Default unprivileged account

Login: perfectlum
Password: plumadmin2912

MySQL Accounts

MySQL Administrator account

Login: root
Password: bemy349R00t

PerfectLum Database account

Login: perfectlum
Password: elj390g#$J@ld0289

Use “perfectlum” MySQL database while installing Remote Management.

Firewall Settings

New incoming connections are accepted for the following TCP ports:

20, 21, 22, 80, 443, 11001

New incoming connections are accepted for the following UDP ports:

68

All other new incoming connections which do not satisfy the stated rules are rejected.
All new incoming connections from localhost are accepted.
All outgoing connections are accepted.

Webmin

Webmin is a web-based interface for system administration for Unix. Using any modern web browser, you can setup user accounts, Apache, DNS, file sharing and much more.

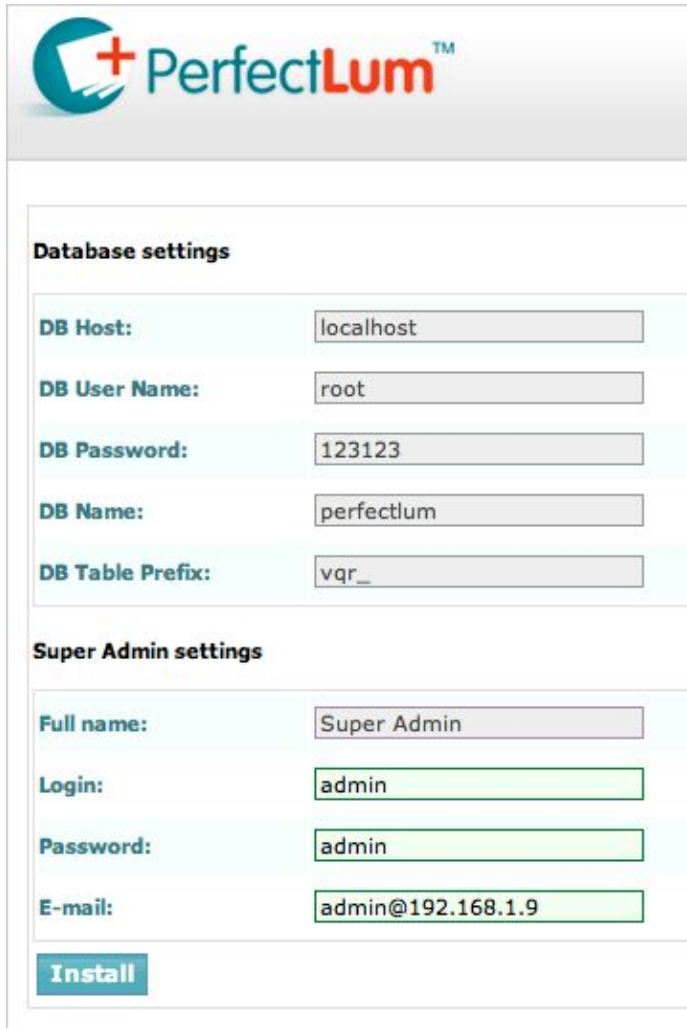
Webmin is listening 11001 TCP port. Point your browser to “http:// VM_IP_ADDRESS:11001” and log in using one of default accounts to use it.

PerfectLum Remote site configuration

Enter the IP address (static IP or DHCP) in your browser.

A setup screen, where you can set the name, password and email of "Super Admin", will appear.

Then click "Install". If the installation was successful,
a congratulation screen will show up.



Before you can connect workstations to Qubyx Remote, some preparations are necessary:

1. In Qubyx Remote, go to the "Setup" tab and then to:
Facilities - create a new facility (e.g. NYU Medical Center)

Workgroups - create at least one workgroup (e.g. CT, Radiology, etc.)
Users - create an admin user

2. Now you can connect from client application Perfectlum Suite to Qubyx Remote New:
- open preferences and go to "Remote and Network Settings"
- enter Qubyx Remote IP as "Server Address"
- enter the admin user you have created and the password for this admin user
- click on the "Enable Remote Management" button.

That's it. Now your workstation is connected to Qubyx Remote and will synchronize its data at certain intervals, which are set in the same dialog.

7.4. Acronyms

DICOM	Digital Imaging and Communications in Medicine
GSDF	Gray Scale Display Function
CIE	Commission Internationale d'Eclairage
BT	Broadcasting service (television)
NEMA	National Electrical Manufacturers Association
AAPM	American Association of Physicists in Medicine
DIN	Deutsches Institut für Normung
IEC	International Electrotechnical Commission
NY PDM	the New York state Primary Diagnostic Monitor (PDM) Quality Assurance Program
JESRA	Japanese Engineering Standards of Radiological Apparatus
LUT	Look Up Table
DDL	Digital Driving Levels
JND	Just-Noticeable Difference
OSD	On Screen Display

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